## RESEARCH PROJECT SEGMENT

*State:* Alaska

*Project No.:* F-9-2 *Name:* Sport Fish Investigations of Alaska.

*Job No.:* 7-B-2 *Title:* **Population Studies of Anadromous Fish Populations-Southwestern Kenai Peninsula and Kachemak Bay.**

*Period Covered:* July 1, 1969 to June 30, 1970.


## ABSTRACT

A creel census conducted during the king salmon, Oncorhynchus tshawytscha, punch-card fishery from May 24-28 on three lower Kenai Peninsula streams resulted in an observed catch of 145 fish over 50.8 cm (20 inches) in fork length. Creel census and punch-card harvest data were projected for a total estimated catch of 255 fish of which 51.3% were taken from the Ninilchik River.

Surveys conducted on Ninilchik River, Deep Creek, Stariski Creek, and Anchor River indicated minimum escapement estimates of 755, 955, 211, and 1,800 king salmon, respectively.

Age groups 1.2 and 1.3 dominated the samples from the Anchor and Ninilchik rivers, while age group 1.2 dominated Deep Creek samples.

King salmon smolts from the Anchor River averaged 93.6 mm fork length and were predominantly age I.

Kenai River king and silver salmon, O. kisutch, smolts were separated by species using fork lengths. The king salmon smolts were predominantly (99.3%) age I, and 92.9% of the smolts sampled were 100 mm or less. Silver salmon smolts were primarily age II (84.3%) and 95.5% were larger than 100 mm.

Results of a partial creel census on the Anchor River, Deep Creek, and the Ninilchik River are presented.


## RECOMMENDATIONS

1. Retain the present objectives of the study.
2. Continue the collection and comparison of population data from king salmon carcasses and from sport-caught king salmon.
3. Delineate silver salmon spawning areas for establishing index sites to determine relative yearly abundance.
4. Continue collecting information on king salmon, silver salmon, and steelhead smolt migration timing, age and growth, and distribution.

5. Continue collecting king and silver salmon smolts in the lower Kenai River to determine age, growth, and migration timing.

## OBJECTIVES

1. To determine the sport fish catch of anadromous fishes and evaluate angling pressure in the fresh waters of the southwestern Kenai Peninsula and the marine waters of Kachemak Bay.

2. To determine population trends for anadromous fish species in the major recreational waters of the southwestern Kenai Peninsula and Kachemak Bay.

3. To determine and develop plans for the enhancement of anadromous fish stocks, to provide recommendations for their management, and to direct the course of future studies.

## TECHNIQUES USED

Creel census of the Kenai Peninsula king salmon, Oncorhynchus tshawytscha, punch-card fishery was described by Engel (1967).

King salmon spawning populations were estimated by foot and aerial surveys as described by Logan (1964) and Engel (1965). During escapement surveys, carcasses were measured for fork length and examined for sex.

Scale samples were collected from adult king salmon and steelhead trout, Salmo gairdneri, caught during the sport fishery on the lower Kenai Peninsula streams. King salmon and steelhead smolts were collected from Anchor River using hook and line. King and silver salmon, O. kisutch, smolts were collected from the Kenai River using four incline plane traps. Scales were read by microprojector to determine the age structure of these stocks.

A partial creel census was conducted to obtain angler harvest and effort information on silver salmon; Dolly Varden, Salvelinus malma; and steelhead trout stocks.

## FINDINGS

A description of the area and prior information collected on this project are presented in Annual Reports of Progress by Dunn (1961), Logan (1962, 1963, 1964), Engel (1965, 1966, 1967), Redick (1968), and McHenry (1969).

In 1966 the Alaska Board of Fish and Game established a quota of 500 king salmon over 50.8 cm (20 inches) in fork length for the Kenai Peninsula. This quota remained in effect during the 1967 and 1968 king salmon punch-card fishery. In view of the poor escapement of king salmon in 1968 in the Anchor and Ninilchik rivers and Deep Creek, the Alaska Board of Fish and Game decided to reduce the area quota in 1969 from 500 king salmon to an area quota of 200 king salmon over 50.8 cm in fork length.

The areas opened to king salmon fishing during the special punch-card fishery, which commenced on May 24 in 1969, are the Anchor River below the junction of the north and south forks, and the lower two miles on Deep Creek and Ninilchik River. Regulation of the 1969 punch-card fishery was identical to that of 1968 with the season being continuous.

### King Salmon Studies

Harvest:

To estimate when the Kenai Peninsula quota of 200 king salmon over 50.8 cm in fork length was reached, an intensive creel census was conducted on Anchor River, Deep Creek, and Ninilchik River. The census commenced on May 24 and remained active through May 28 when a total of 145 king salmon were observed.

The king salmon season on the Kenai River extended from July 19-27. As in past years, few fishermen fished the Kenai River; therefore, no creel census was attempted. The largest number of fishermen on the river was on July 20 when 49 people were observed in a ten-mile section between Soldotna Creek and Eagle Rock.

Stream conditions appeared to be closely correlated with fishing success and effort on each of the lower Kenai Peninsula streams. The large catch from the Ninilchik River can be attributed to low, clean water conditions which prevailed throughout the fishery. Much of the expected effort on Anchor River and Deep Creek was diverted to the Ninilchik River because of the high, turbid stream flows that existed on these two streams during the first four days of the fishery. By the last day of the fishery, stream conditions improved and catches increased on Anchor River and Deep Creek. As in the past three years, a sharp decline in the catch occurred on the second day, which follows Engel's (1967) suggestion that the first day's harvest consists of vulnerable "holding" fish, the survivors of which probably remain in hiding or migrate upstream by the second day.

Table 1 shows the daily observed harvest compared with the total known harvest from each stream. The known harvest was determined by adding the number of fish creel-checked to the number of fish not creel-checked but reported by punch-card returnees. Contrary to previous years, the Ninilchik River contributed 51.3% of the total known harvest. Anchor River and Deep Creek contributed 33.0 and 15.7%, respectively, to the total known harvest.

**TABLE 1** Observed and (Known) King Salmon Harvest, Timing, and Distribution of Kenai Peninsula Streams, 1969.

| Date | Anchor River | Ninilchik River | Deep Creek | Cumulative Totals |
|---|---|---|---|---|
| 5/24 | 20 (24) | 37 (69) | 8 (10) | 65 (103) |
| 5/25 | 4 ( 7) | 4 ( 8) | 2 ( 3) | 75 (121) |
| 5/26 | 3 ( 5) | 10 (13) | 3 ( 5) | 91 (144) |
| 5/27 | 4 (11) | 14 (17) | 4 ( 5) | 113 (177) |
| 5/28 | 14 (31) | 6 (14) | 12 (14) | 145 (236) |
| Total | 45 (78) | 71 (121) | 29 (37) | 145 (236) |
| % of Catch | 33.0 | 51.3 | 15.7 | 100.0 |

A total of 6,680 king salmon punch cards were issued in 1969. Of these, 4,651 (69.6%) were voluntarily returned which compares with the 70.6% return in 1968. The total number of punch cards issued in 1969 was 2,844 (29.9%) less than the 9,524 issued in 1968. This decrease was probably due to the reduced Kenai Peninsula king salmon quota. The returnees reported a harvest of 211 king salmon from the lower Kenai

Peninsula streams and 18 king salmon from the Kenai River.

Redick's (1968) ratio was used to estimate the number of fish caught by punch-card non-returnees:

$$\frac{\text{Fish creel-checked}}{\text{Punch card not returned}} = \frac{\text{Fish not creel-checked}}{\text{Punch card not returned}}$$

$$\frac{120}{25} = \frac{91}{x}$$

$$x = 19$$

This ratio estimated a total catch composed of:

| | |
|---|---|
| Total fish creel-checked | 145 |
| Punch cards returned, fish not checked | 91 |
| Punch cards not returned, fish not checked | 19 |
| Total estimated catch | 255 |

This ratio assumes that the punch-card rate of return is the same for anglers whose fish were not creel-checked (Redick, 1968). The 18 Kenai River king salmon were omitted from the above calculation since no creel census was conducted on that stream.

The projected total of 255 king salmon is believed to be the most accurate estimate of the true sport harvest. The contribution by stream was as follows: Anchor River - 84, Ninilchik River - 131, and Deep Creek - 40. The total estimated catch per stream was calculated by multiplying each stream's percent contribution to the total reported harvest times the 19 unreported fish, and adding that amount to each stream's known harvest.

Of the total estimated 255 king salmon caught, 145 (56.9%) were observed. Limit catches (two fish per angler) comprised 20.3% of the reported harvest, and were taken by 11.3% of the successful anglers. This rate is considerably lower than the 21.2, 22.0, and 22.1% reported for the 1966, 1967, and 1968 punch-card fisheries, respectively.

Escapement:

Aerial and foot surveys were conducted to estimate spawning king salmon populations in the Anchor and Ninilchik rivers and Stariski and Deep creeks. Surveys were conducted during the peak of spawning which occurred during the latter part of July and the first week in August. Clear skies and low, clear water conditions provided optimum conditions for the escapement surveys.

The Anchor River spawning population was estimated to be 1,800 king salmon in 1969. This estimate is a 51.3% increase over the 1960-1968 average of 1,190 fish and is the largest recorded escapement since 1960. Table 2 summarizes Anchor River minimum spawning escapements, sex ratios, and estimated number of spawning females for 1960-1969. Adding the estimated sport harvest of 84 fish to the estimated escapement of 1,800, the total 1969 Anchor River king salmon run was estimated at 1,884 fish.

The Anchor River male-to-female carcass ratio of 1.5:1 is comparable to the sport catch sex ratio of 1.2:1. The difference in sex ratios is due to a greater angler selection toward larger four- and five-year-old fish which would exclude three-year-old males. By adding the punch-card reported 12 "jacks" (less than 20 inches) to the sport catch, the resulting sex ratio is 1.8:1. The combined carcass and sport-catch data (including jacks) indicates a 1.5:1 male-to-female ratio. An estimated 720 females spawned in 1969 (Table 2).

**TABLE 2** Summary of Escapement, Sex Ratios, and Estimated Number of Spawning Female King Salmon, Anchor River, 1960-1969.

| Year | Est. Total Escapement | Male:Female Sex Ratio | Est. Spawning Females | Method of Determination |
|---|---|---|---|---|
| 1960 | 1,200 | 0.9:1 | 631 | Aerial & foot survey |
| 1961 | 850 | 1.2:1 | 386 | Aerial & foot survey |
| 1962 | 970 | 0.8:1 | 539 | Aerial & foot survey |
| 1963 | 1,340 | 1.0:1 | 670 | Aerial & foot survey |
| 1964 | 1,700 | 1.4:1 | 708 | Aerial & foot survey |
| 1965 | 1,600 | 1.7:1 | 593 | Aerial & foot survey |
| 1966 | 1,325 | 0.8:1 | 736 | Foot surveys |
| 1967 | 1,195 | 0.7:1 | 700 | Aerial & foot survey |
| 1968 | 528 | 1.7:1 | 195 | Aerial & foot survey |
| 1969 | 1,800 | 1.5:1 | 720 | Aerial & foot survey |
| 1960-1968 average | 1,190 | 1.1:1 | 573 | |

Estimated miminum spawning king salmon populations from 1967 to 1969 in Deep and Stariski creeks and Ninilchik River are summarized in Table 3. The escapement in Deep Creek was the highest recorded since the counts began in 1962. Stariski Creek's estimated spawning population was 32% lower than the 1962-1968 average, while Deep Creek and Ninilchik River estimated escapements were 74 and 43%, respectively, higher than the 1962-1968 average.

**TABLE 3** Estimated King Salmon Escapements for Deep Creek, Stariski Creek, and the Ninilchik River, 1962-1969.

| Date | Deep Creek | Stariski Creek* | Ninilchik River |
|---|---|---|---|
| 1962 | 745 | 355 | 525 |
| 1963 | 605 | 265 | 450 |
| 1964 | 800 | 582 | 910 |
| 1965 | 690 | 330 | 1,025 |
| 1966 | 540 | --- | 670 |
| 1967 | 265 | 195 | 360 |
| 1968 | 195 | 124 | 450 |
| 1969 | 955 | 211 | 755 |
| 1962-1968 average | 549 | 309 | 627 |

*Escapement counts were not obtained in 1966.

The male-to-female sport-catch sex ratio in the Ninilchik River was 1.7:1. A total of nine "jacks" were also caught, and if added to the sport catch, the resulting sex ratio would be 2.1:1 which closely resembles the carcass sex ratio of 2.0:1. By extrapolation, the total estimated escapement of 755 king salmon consisted of 503 males and 252 females.

No estimates of the sex ratios could be made for Deep or Stariski creeks because of insufficient carcasses and a low sport catch on Deep Creek.

Table 4 describes the relative effectiveness of Kenai Peninsula king salmon survey techniques from 1962-1969. The percent of the run within the index areas, as estimated by aerial survey, has varied considerably from year to year. This phenomenon is believed to be due to differences in weather and stream conditions and observers. Stream conditions are probably the greatest contributing factor to these fluctuations since water levels may influence the distribution of salmon observed in the index areas.

**TABLE 4** Relative Effectiveness of King Salmon Aerial and Foot Surveys on Kenai Peninsula Streams, 1962-1969.

| Stream | Year | % Success of Aerial vs Foot Surveys Within Index Areas | Est. % of Run Within Index Area by Aerial Survey |
|---|---|---|---|
| Anchor River | 1962 | 31/212 = 14.6 | 31/196 = 15.8 |
| | 1963 | 112/454 = 24.7 | 112/239 = 46.9 |
| | 1964 | 89/299 = 29.8 | 89/379 = 23.5 |
| | 1965 | 39/347 = 11.2 | 39/180 = 21.7 |
| | 1966 | No aerial survey | /300 = ---- |
| | 1967 | 64/210 = 30.5 | 64/363 = 17.6 |
| | 1968 | 42/114 = 36.8 | 42/176 = 23.9 |
| | 1969 | 45/288 = 15.6 | 45/281 = 16.0 |
| Deep Creek | 1962 | 28/ 89 = 31.5 | 28/191 = 14.7 |
| | 1963 | 138/400 = 34.5 | 138/258 = 53.5 |
| | 1964 | 57/275 = 20.7 | 57/165 = 34.5 |
| | 1965 | 31/167 = 18.6 | 31/128 = 24.2 |
| | 1966 | No aerial survey | /107 = ---- |
| | 1967 | 20/139 = 14.4 | 20/ 38 = 52.6 |
| | 1968 | 25/ 67 = 37.3 | 25/ 73 = 34.2 |
| | 1969 | 13/115 = 11.3 | 13/108 = 12.0 |
| Ninilchik River | 1962 | 15/ 47 = 31.9 | 15/143 = 10.5 |
| | 1963 | 73/179 = 40.8 | 73/193 = 37.8 |
| | 1964 | 76/200 = 38.0 | 76/347 = 21.9 |
| | 1965 | 70/224 = 31.3 | 70/219 = 21.9 |
| | 1966 | No aerial survey | /231 = ---- |
| | 1967 | 59/100 = 59.0 | 59/213 = 27.7 |
| | 1968 | 19/ 31 = 61.3 | 19/126 = 15.1 |
| | 1969 | 22/ 87 = 25.3 | 22/191 = 11.5 |
| Stariski Creek | 1962 | 3/ 18 = 16.7 | 3/ 44 = 6.8 |
| | 1963 | 11/ 53 = 20.8 | 11/ 74 = 14.9 |
| | 1964 | 61/152 = 40.1 | 61/234 = 26.1 |
| | 1965 | 23/ 94 = 24.5 | 23/ 80 = 28.8 |
| | 1966 | No aerial survey | No count |
| | 1967 | 13/ 31 = 41.9 | 13/ 82 = 15.9 |
| | 1968 | 7/ 29 = 24.1 | 7/ 30 = 23.3 |
| | 1969 | 8/ 24 = 33.3 | 8/ 70 = 11.4 |

Population Structure - Anchor River:

Information on the population structure of king salmon in the Anchor River was collected from both sport-caught fish and carcasses. Figure 1 shows a comparison of length frequencies between sport-caught fish and carcasses. The only similarity between the carcass and sport fish length frequencies of males occurs in the 55 - 75 cm range which is predominantly age 1.2 fish. The lack of sport-caught king salmon in the larger size classes is probably due to the small size of the sample. Carcass length frequencies of females were similar to those of the sport catch. Despite the small sample size of sport-caught king salmon, the carcass length frequencies (sexes combined) closely resembled those of the sport catch.

Redick (1968) noted that the timing of carcass sampling is important because of an apparent differential die-off period of the sexes. Because of this differential, the carcass sex ratio and length frequency data could be biased, which makes the timing of carcass recoveries crucial.

Scales were collected from 36 sport-caught king salmon over 20 inches. Age group frequencies and mean lengths by sex from 1960-1969 are presented in Table 5. These age groups cannot necessarily be considered representative of the age composition. The sample size was small in relation to the total spawning population and was collected early in the run. Contrary to data collected in previous years, the dominant age group was age 1.2 which comprised 47.2% of the sample, while age 1.3 comprised 38.9% of the sample. The age 1.2 fish were primarily males (94%). Table 6 summarizes king salmon length frequency data collected from 1964-1969.

Population Structure - Ninilchik River:

Population data was compiled from carcasses and sport-caught king salmon collected from the Ninilchik River. Length frequency data of carcasses and sport-caught king salmon in 1969 are compared in Figure 2. The carcass length frequencies (combined sexes) is comparable to the length frequencies of the sport catch except for the large number of fish in the 80 - 85 cm range which were all age 1.3.

Scales from 64 sport-caught king salmon were analyzed. Table 7 presents age group frequencies from 1966-1969. Age group 1.3 was the dominant year class comprising 50.0% of the sample. Age group 1.2 (34.4%) was the next most abundant year class. Progeny of the 1964 brood year dominated the fishery in 1968 and 1969 as age groups 1.2 and 1.3, respectively. In 1964 the escapement was the second highest recorded (910) from 1962-1969. The escapement in 1965 was the largest on record (1,025). The progeny of the 1965 brood year appeared as age group 1.2 in 1969.

**TABLE 7** Age Group Frequency of King Salmon by Percent, Ninilchik River, 1966-1969.

| | | Age Group | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Sample Size | 1.1 | 1.2 | 2.2 | 1.3 | 2.3 | 1.4 | 2.4 | 1.5 |
| 1966 | 82 | --- | 22.0 | --- | 45.2 | 2.2 | 30.4 | --- | --- |
| 1967 | 78 | 2.6 | 6.4 | 1.3 | 30.8 | 1.3 | 56.4 | --- | 1.3 |
| 1968 | 100 | 4.0 | 42.0 | 1.0 | 21.0 | 1.0 | 30.0 | 1.0 | --- |
| 1969 | 64 | --- | 34.4 | 3.1 | 50.0 | --- | 12.5 | --- | --- |

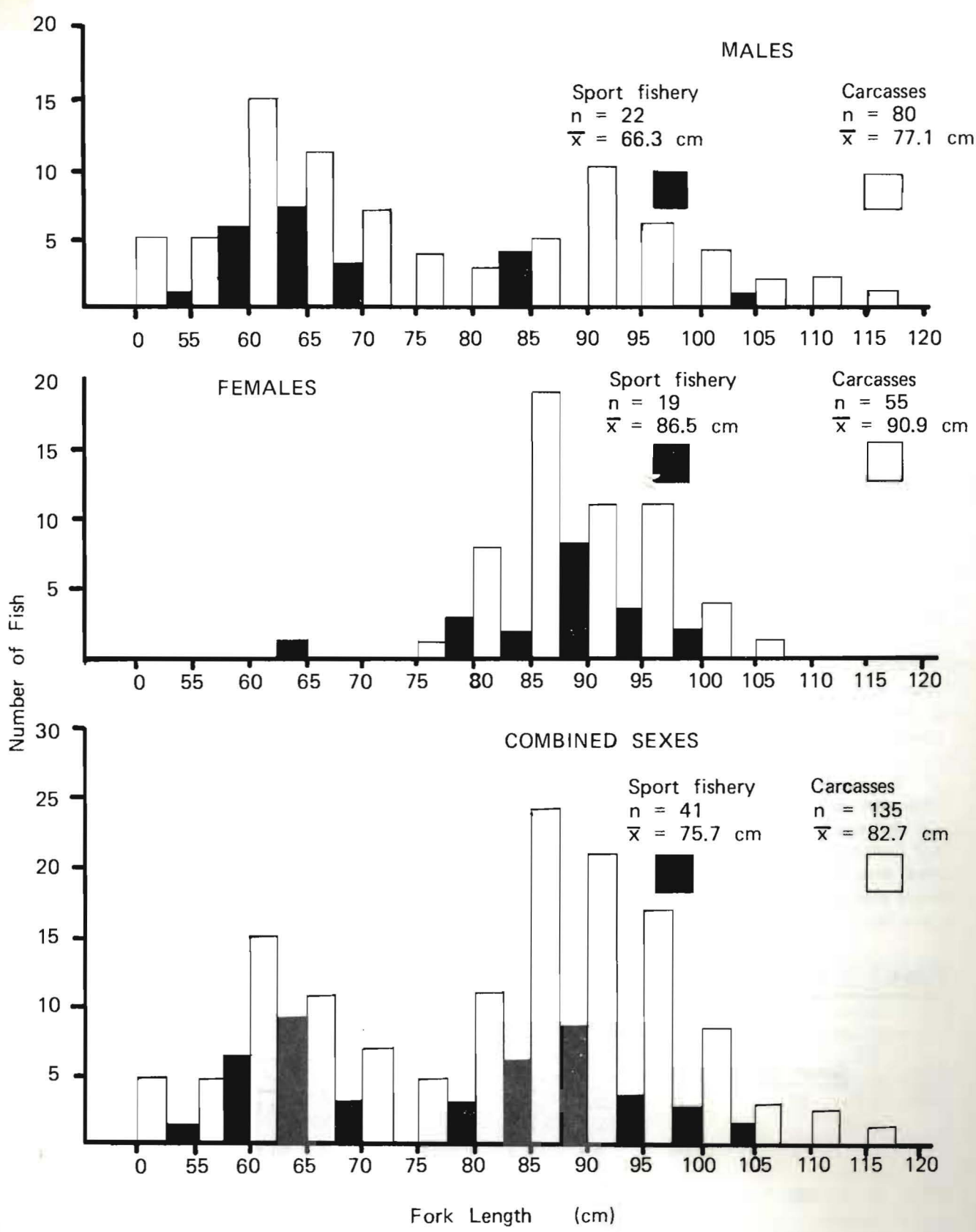


FIGURE 1 LENGTH-FREQUENCY OF KING SALMON CARCASSES AND SPORT-CAUGHT KING SALMON, ANCHOR RIVER, 1969.

**TABLE 5** Age Class Frequency and Mean Sizes by Sex of Anchor River King Salmon Samples, 1960-1969.

| Year | Sample Size | Age Group by Percent | | | | | Mean Length (cm) & (No. in Sample) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | i.1* | 1.2 | 1.3 | 1.4 | All Other | Male | Female | Combined |
| 1960 | 199 | 2.7 | 6.5 | 76.0 | 11.0 | 3.8 | 82.3 (88) | 82.3 (95) | 84.1 (183) |
| 1961 | 112 | 2.9 | 10.6 | 21.1 | 64.4 | 1.0 | 87.0 (58) | 93.8 (49) | 90.1 (107) |
| 1962 | 47 | --- | 31.9 | 40.4 | 27.7 | --- | 79.5 (31) | 85.9 (40) | 83.1 (71) |
| 1963 | 99 | 10.1 | 19.2 | 49.5 | 20.2 | 1.0 | 71.9 (77) | 90.6 (75) | 81.1 (152) |
| 1964 | --- | Carcasses only - No sport fishery | | | | | 86.1 (60) | 91.5 (44) | 88.4 (104) |
| 1965 | --- | Carcasses only - No sport fishery | | | | | 83.5 (106) | 90.7 (62) | 86.1 (168) |
| 1966 | 151 | 2.6 | 19.2 | 42.4 | 30.5 | 5.3 | 77.6 (79) | 89.5 (95) | 84.1 (174) |
| 1967 | 112 | 1.8 | 8.9 | 22.3 | 66.1 | 0.9 | 91.8 (97) | 94.1 (135) | 93.2 (232) |
| 1968 | 168 | 0.6 | 20.8 | 31.0 | 46.4 | 1.2 | 80.8 (151) | 91.7 (116) | 85.5 (267) |
| 1969 | 36 | 2.8 | 47.2 | 38.9 | 11.1 | --- | 74.8 (102) | 89.7 (74) | 81.1 (176) |

*The percent composition of this age group is small because angler and gear selectivity for king salmon larger than 20 inches generally excludes age 1.1 "jacks".

**TABLE 6** A Summary of King Salmon Length Frequency Data, Anchor River, 1964-1968.

| Year | | 0-50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 | 105 | 110 | 115 | 120 | Average Length | Total Fish |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 - | Male | 5 | - | 1 | 1 | 4 | 5 | 3 | 4 | 4 | 9 | 6 | 7 | 8 | 3 | - | 60 | 86.1 |
| | Female | - | - | - | - | - | - | - | 3 | 16 | 13 | 7 | 5 | - | - | - | 44 | 91.5 |
| | Combined | 5 | - | 1 | 1 | 4 | 5 | 3 | 7 | 20 | 22 | 13 | 12 | 8 | 3 | - | 104 | 88.4 |
| 1965 - | Male | 2 | 2 | 8 | 8 | 17 | 4 | 3 | 2 | 8 | 12 | 18 | 17 | 3 | 2 | - | 106 | 83.5 |
| | Female | - | - | - | - | - | - | 3 | 9 | 21 | 14 | 9 | 5 | - | 1 | - | 62 | 90.7 |
| | Combined | 2 | 2 | 8 | 8 | 17 | 4 | 6 | 11 | 29 | 26 | 27 | 22 | 3 | 3 | - | 168 | 86.1 |
| 1966 - | Male | - | 4 | 16 | 9 | 2 | 1 | 3 | 8 | 15 | 12 | 5 | 2 | 1 | 1 | - | 79 | 77.6 |
| | Female | - | - | - | 1 | - | 1 | 2 | 18 | 30 | 20 | 15 | 8 | - | - | - | 95 | 89.5 |
| | Combined | - | 4 | 16 | 10 | 2 | 2 | 5 | 26 | 45 | 32 | 20 | 10 | 1 | 1 | - | 174 | 84.1 |
| 1967 - | Male | 6 | - | 3 | 5 | 3 | 2 | 5 | 8 | 7 | 6 | 3 | 6 | 22 | 19 | 2 | 97 | 91.8 |
| | Female | - | - | - | - | 3 | - | 2 | 6 | 26 | 29 | 37 | 28 | 4 | - | - | 135 | 94.1 |
| | Combined | 6 | - | 3 | 5 | 6 | 2 | 7 | 14 | 33 | 35 | 40 | 34 | 26 | 19 | 2 | 232 | 93.2 |
| 1968 - | Male | 9 | - | 4 | 23 | 22 | 9 | 4 | 7 | 12 | 18 | 11 | 14 | 11 | 5 | 2 | 151 | 80.8 |
| | Female | - | - | - | - | - | 1 | 1 | 16 | 26 | 31 | 31 | 7 | 3 | - | - | 116 | 91.7 |
| | Combined | 9 | - | 4 | 23 | 22 | 10 | 5 | 23 | 38 | 49 | 42 | 21 | 14 | 5 | 2 | 267 | 85.5 |
| 1969 - | Male | 2 | 4 | 11 | 22 | 14 | 7 | 4 | 7 | 5 | 10 | 6 | 5 | 2 | 2 | 1 | 102 | 74.8 |
| | Female | - | - | - | 1 | - | - | 4 | 10 | 27 | 14 | 13 | 4 | 1 | - | - | 74 | 89.7 |
| | Combined | 2 | 4 | 11 | 23 | 14 | 7 | 8 | 17 | 32 | 24 | 19 | 9 | 3 | 2 | 1 | 176 | 81.1 |

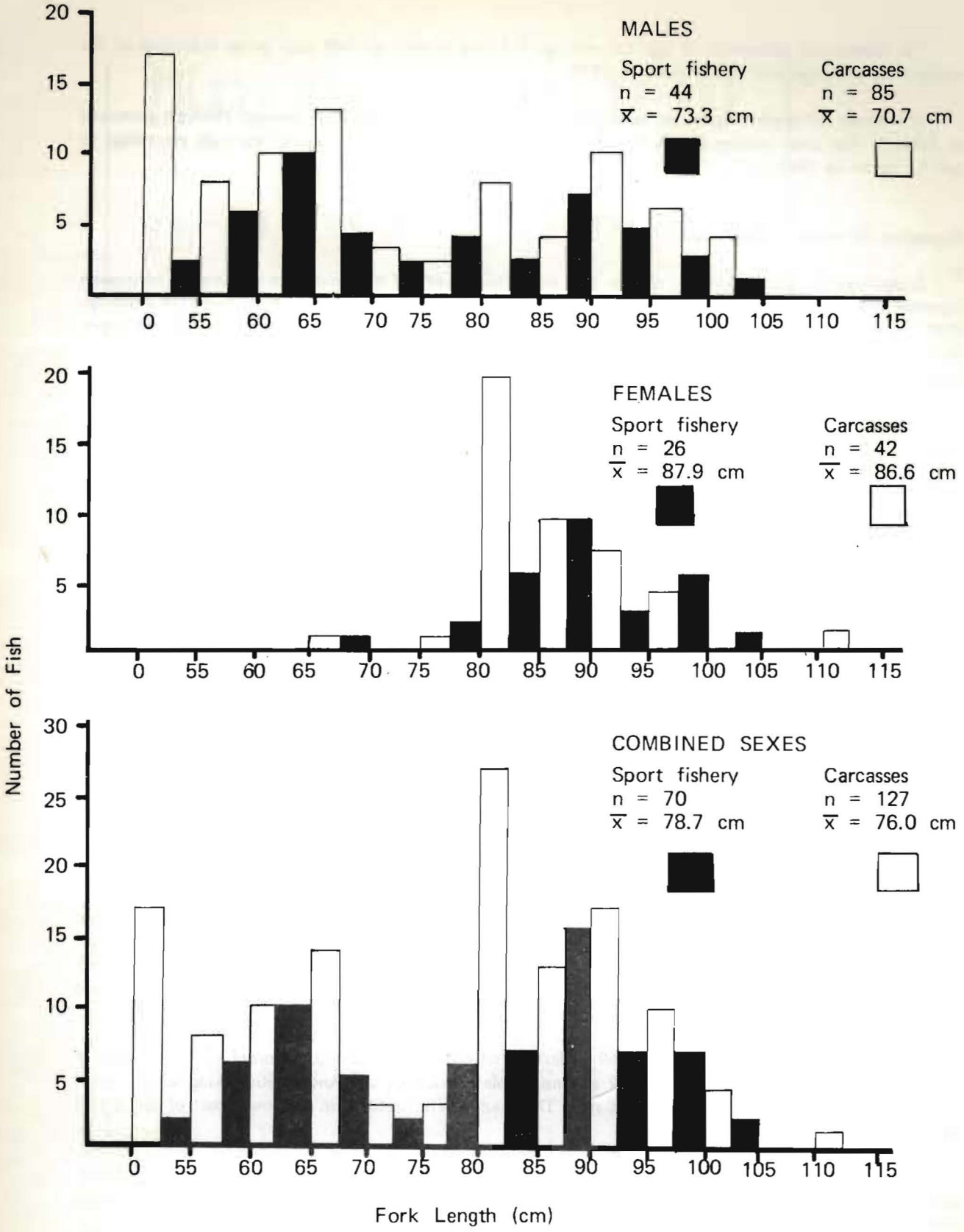


FIGURE 2 LENGTH-FREQUENCY OF KING SALMON CARCASSES AND SPORT-CAUGHT KING SALMON, NINILCHIK RIVER, 1969.

The substantial occurrence of age 1.2 and age 1.3 king salmon in 1969 may be an indication of the strength of the respective brood years in 1970.

A summary of length frequencies, sample sizes, and mean lengths from 1964 through 1969 are presented in Table 8. The small average length for all males and the total sample is due to the high percentage of age 1.2 males in 1969.

Population Structure - Deep Creek:

Scales from 28 sport-caught king salmon were analyzed. The size of the sample was too small to adequately represent the population's age structure. Table 9 is a summary of age group frequencies from 1967 through 1969. Age group 1.2 comprised 78.6% of the sport catch. Out of the 28 fish in the sample, 24 were males. Because of an insufficient carcass recovery and small sport catch, no length frequency data is presented for Deep Creek.

**TABLE 9** Age Group Frequency of King Salmon by Percent, Deep Creek, 1967-1969.

| | | Age Group | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Sample Size | 1.1 | 2.1 | 0.2 | 1.2 | 2.2 | 1.3 | 2.3 | 1.4 | 2.4 |
| 1967 | 107 | 6.5 | 0.9 | 0.9 | 21.6 | 3.7 | 29.0 | 0.9 | 35.6 | 0.9 |
| 1968 | 105 | 2.9 | --- | --- | 32.4 | 3.8 | 32.4 | 0.9 | 26.7 | 0.9 |
| 1969 | 28 | --- | --- | --- | 78.6 | --- | 17.8 | --- | 3.6 | --- |

Scale Characteristics:

Redick (1968) studied the scale characteristics of king salmon smolts collected on June 23 from the Ninilchik River and Deep Creek. He found that 35 smolts from Ninilchik River averaged 94.3 mm as opposed to 78.4 mm for 31 smolts from Deep Creek. The data indicated that considerable growth occurred after the first annulus which meant the smolts remained in the stream during a substantial portion of their second growing season.

On July 8, 1969, a total of 56 king salmon smolts were collected by hook and line from the Anchor River. These fish were abundant in the stream at this time. Fifty-five smolts were age 1 with current year growth; one was a young-of-the-year juvenile. The 55 smolts averaged 93.6 mm which is similar to the Ninilchik River smolts which averaged 94.3 mm in 1967. A summary of circuli counts and size distribution of smolts from the Anchor River is shown in Table 10.

As in 1967, the data collected in 1969 indicates that considerable growth occurred after formation of the first annulus. It appears that in 1969 a considerable portion of the Anchor River king salmon smolt population was still present in the river in July. The smolts were captured in the lower part of the stream which is influenced by tidal action.

Scales from 18 steelhead smolts collected during the month of July from the Anchor River were analyzed. Sixteen of the smolts had two freshwater annuli while two had three freshwater annuli. Age II smolts averaged 165.7 mm fork length and age III smolts averaged 193.5 mm.

**TABLE 8** A Summary of King Salmon Length Frequency Data, Ninilchik River, 1964-1969.

| Year | | 0-50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 | 105 | 110 | 115 | 120 | Total Fish | Average Length |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 - | Male | 6 | - | 1 | 6 | 5 | 7 | - | 4 | 7 | 5 | 4 | 4 | 7 | 1 | - | 57 | 80.5 |
| | Female | - | - | - | - | - | - | 1 | 16 | 12 | 11 | 3 | - | - | - | - | 43 | 86.9 |
| | Combined | 6 | - | 1 | 6 | 5 | 7 | 1 | 20 | 19 | 16 | 7 | 4 | 7 | 1 | - | 100 | 83.3 |
| 1965 - | Male | 5 | 1 | - | 4 | 2 | - | - | 3 | 7 | 5 | 7 | 6 | 3 | 1 | 2 | 46 | 84.9 |
| | Female | - | - | - | - | - | - | 2 | 9 | 15 | 12 | 7 | 2 | - | - | - | 47 | 89.3 |
| | Combined | 5 | 1 | - | 4 | 2 | - | 2 | 12 | 22 | 17 | 14 | 8 | 3 | 1 | 2 | 93 | 87.1 |
| 1966 - | Male | - | 1 | 9 | 12 | 3 | - | 3 | 7 | 8 | 8 | 4 | 1 | 1 | 2 | - | 59 | 77.8 |
| | Female | - | - | - | - | - | 1 | 3 | 12 | 12 | 14 | 7 | 2 | - | - | - | 51 | 88.3 |
| | Combined | - | 1 | 9 | 12 | 3 | 1 | 6 | 19 | 20 | 22 | 11 | 3 | 1 | 2 | - | 110 | 82.7 |
| 1967 - | Male | 2 | 2 | 3 | - | 1 | 1 | 1 | 4 | 3 | 4 | 2 | 5 | 4 | 1 | - | 33 | 80.4 |
| | Female | - | - | - | - | - | - | 4 | 6 | 8 | 11 | 13 | 6 | 1 | - | - | 49 | 91.4 |
| | Combined | 2 | 2 | 3 | - | 1 | 1 | 5 | 10 | 11 | 15 | 15 | 11 | 5 | 1 | - | 82 | 87.3 |
| 1968 - | Male | 5 | - | 5 | 30 | 14 | - | 2 | - | 4 | 3 | 1 | 3 | 1 | - | - | 68 | 67.4 |
| | Female | - | - | - | - | 1 | 1 | - | 2 | 12 | 12 | 11 | 1 | - | - | - | 40 | 90.9 |
| | Combined | 5 | - | 5 | 30 | 15 | 1 | 2 | 2 | 16 | 15 | 12 | 4 | 1 | - | - | 108 | 76.1 |
| 1969 - | Male | 12 | 7 | 14 | 20 | 17 | 5 | 6 | 10 | 11 | 14 | 8 | 5 | - | - | - | 129 | 71.6 |
| | Female | - | - | - | - | 2 | - | 3 | 24 | 18 | 10 | 9 | 1 | - | 1 | - | 68 | 87.1 |
| | Combined | 12 | 7 | 14 | 20 | 19 | 5 | 9 | 34 | 29 | 24 | 17 | 6 | - | 1 | - | 197 | 76.9 |

**TABLE 10** Circuli Counts and Size Distribution of King Salmon Smolts, Anchor River, July 8, 1969.

| No. of Smolts | Length (mm) | Circuli Past Annulus | | | |
|---|---|---|---|---|---|
| | | 3 | 4 | 5 | 6 |
| 3 | 80 - 84 | 3 | -- | -- | -- |
| 11 | 85 - 89 | 6 | 5 | -- | -- |
| 21 | 90 - 94 | 6 | 11 | 3 | 1 |
| 9 | 95 - 99 | 1 | 6 | -- | 2 |
| 8 | 100 - 104 | -- | 1 | 5 | 2 |
| 3 | 105 - 109 | -- | -- | 2 | 1 |
| 55 | | | | | |

Kenai River Smolt Studies

Since 1967 the Commercial Fisheries Division of the Alaska Department of Fish and Game has sampled the Kenai River red salmon, O. nerka, smolt migration using four incline plane traps which were located under the Sterling Highway bridge at Soldotna. Samples of incidentally caught king and silver salmon smolts were collected from May 28 to June 18.

Meehan and Vania (1961) and Dalhberg and Phinney (1967) found that the adipose fin of silver salmon in many Alaskan streams is completely pigmented, while those of king salmon had a clear area near the anterior fin base. Engel (1968) verified this characteristic for Kenai River smolts and also found that 98.7% of the king salmon smolts were less than 100 mm in fork length, and 92.8% of the silver salmon smolts were larger than 100 mm. Therefore, in 1968 and 1969, each weekly sample was separated into two size groups. Smolts 100 mm and under in fork length were considered to be king salmon and those over 100 mm were assumed to be silver salmon. Each smolt was subsequently checked for proper species identification by noting the pigmentation of its adipose fin.

In 1968 a total of 336 king salmon smolts and 168 silver salmon smolts were sampled. Of the king salmon smolts, 97.9% were smaller than 100 mm while 100% of the silver salmon smolts were over 100 mm in fork length. In 1969 a total of 294 king salmon smolts, 92.9%, were 100 mm or less; 95.5% of the silver salmon smolts were larger than 100 mm in fork length. It appears that silver and king salmon smolts in the Kenai River can be distinguished solely on size differential using 100 mm in fork length to separate the two species.

Age and size composition data from Kenai River king salmon smolt samples collected from 1967-1969 are presented in Table 11.

In 1969 the king salmon sample consisted primarily of age I smolts (99.3%) which has been the predominant age group since sampling began in 1967. Since 1967, the size range of age I smolts has steadily increased. This size increase could possibly be due to sampling selectivity since the Kenai River system is large with many diversified lakes and streams.

Age and size composition data from Kenai River silver salmon smolt samples collected from 1967-1969 are shown in Table 12.

Since 1967, the predominant age group of the silver salmon smolt samples has been age II fish. The

size range of all ages of smolts has varied from year to year, but the average size of age II silver salmon smolts has declined from 125.0 mm in 1967 to 118.8 mm in 1969. This decrease in average size may be attributed to the same reasons previously stated for the king salmon smolt average size increase.

**TABLE 11** Age and Size Composition of Kenai River King Salmon Smolt Samples, 1967-1969.

| Year | Age | Sample Size | % of Sample | Range (mm) | Mean |
|---|---|---|---|---|---|
| 1967 | 0 | 5 | 1.7 | 35 - 40 | 39.4 |
| | I | 287 | 96.0 | 50 - 98 | 73.9 |
| | II | 7 | 2.3 | 95 - 113 | 103.0 |
| 1968 | 0 | 1 | 0.3 | 44 | 44.0 |
| | I | 305 | 90.8 | 57 - 99 | 78.6 |
| | II | 30 | 8.9 | 78 - 111 | 96.5 |
| 1969 | I | 292 | 99.3 | 64 - 106 | 87.5 |
| | II | 2 | 0.7 | 103 - 106 | 104.5 |

**TABLE 12** Age and Size Composition of Kenai River Silver Salmon Smolt Samples, 1967-1969.

| Year | Age | Sample Size | % of Sample | Range (mm) | Mean |
|---|---|---|---|---|---|
| 1967 | I | 6 | 4.3 | 50 - 65 | 54.7 |
| | II | 125 | 89.9 | 85 - 155 | 125.0 |
| | III | 8 | 5.8 | 136 - 173 | 151.9 |
| 1968 | I | 2 | 1.2 | 100 - 105 | 100.5 |
| | II | 121 | 72.0 | 104 - 155 | 121.8 |
| | III | 45 | 26.8 | 121 - 171 | 145.0 |
| 1969 | I | 3 | 1.7 | 66 - 77 | 73.0 |
| | II | 151 | 84.3 | 95 - 142 | 118.8 |
| | III | 25 | 14.0 | 129 - 176 | 144.9 |

Age-length relationships of the king and silver salmon smolt samples collected in 1969 are shown in Figure 3.

Creel Census

Fishing effort on lower Kenai Peninsula streams during the summer of 1969 was extremely light in comparison to recent years. It is believed that this decrease was primarily caused by the extremely high fire hazard present during the summer months which resulted in an access closure on all federal and state lands. These restrictions discouraged many people from fishing on the Kenai Peninsula.

Anchor River:

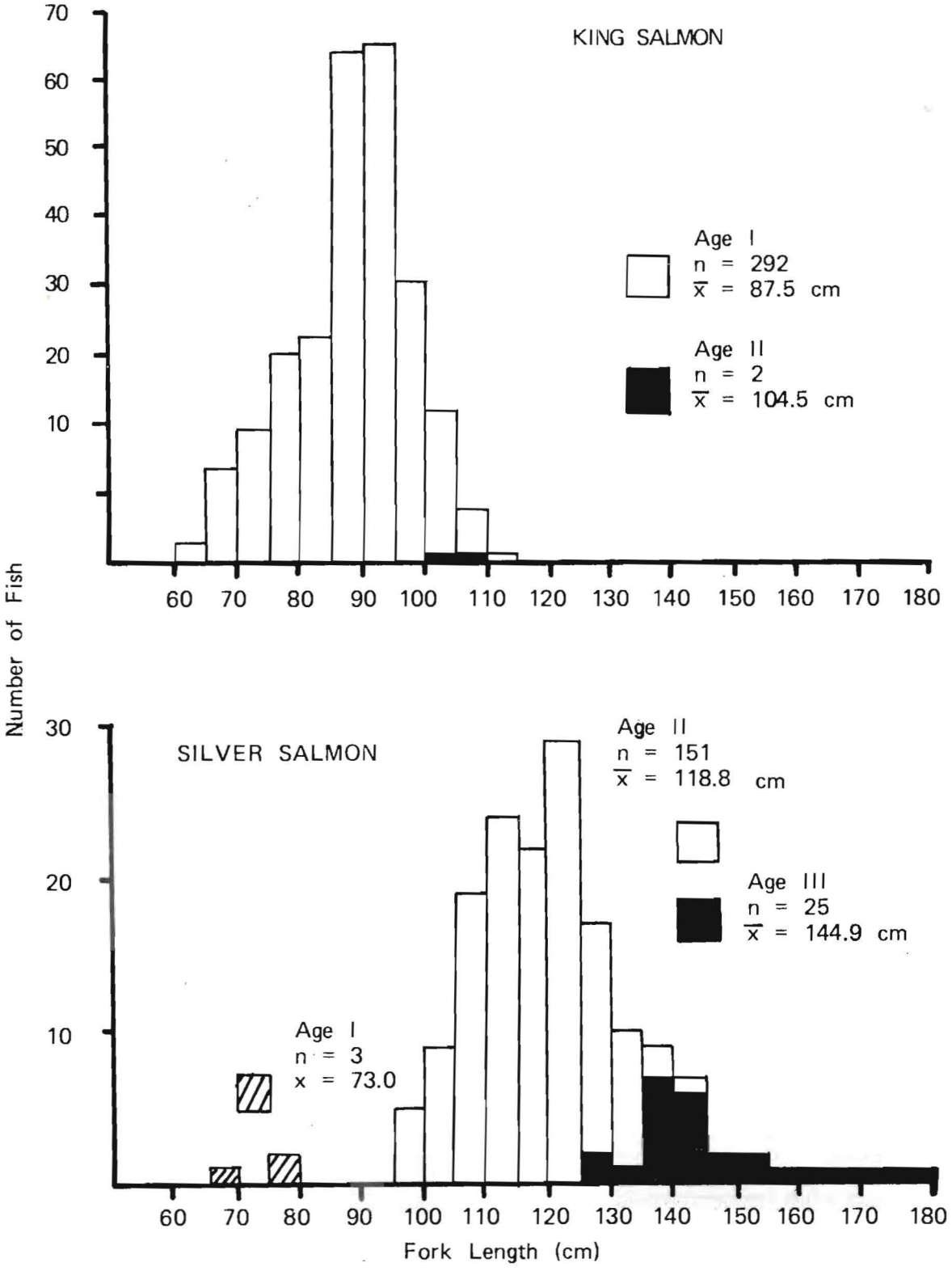


FIGURE 3 THE RELATIONSHIP OF LENGTH TO AGE OF KENAI RIVER KING AND SILVER SALMON SMOLTS, 1969.

During July, creel checks were made on two weekend days and one holiday. Creel census information revealed that only 15 fishermen were contacted during these three days. They reported fishing 30.5 hours and catching eight steelhead smolt and two rainbow trout. Usually the Dolly Varden fishery begins during the first week in July. In 1969 Dolly Varden did not appear in large numbers until the end of July. It appeared that most of the effort on Dolly Varden occurred from August 1-15. During this period, four creel checks were made and a total of 24 fishermen were contacted. They reported fishing 67 hours and catching 99 Dolly Varden for a catch per hour of 1.5 fish.

From August 16 through September 28, nine creel checks were made an a total of 88 fishermen were contacted. They reported catching a total of 47 silver salmon and 38 Dolly Varden in 221.5 hours of fishing for a catch per hour of 0.21 and 0.17, respectively.

Thirteen steelhead trout are known to havy been caught from the Anchor River with the best fishing occurring in October.

Deep Creek:

As in 1968, a red salmon fishery occurred off the mouth of Deep Creek. These fish were probably bound for the Kenai and Kasilof rivers. The red salmon appeared to be abundant for approximately two weeks during mid-July. This was strictly a snag fishery during high tides. A boat was necessary to be successful. As high as twelve boats were observed at one time off the mouth in tidal water.

A total of 40 fishermen were interviewed from August 3 through September 13 during eight creel checks. They reported catching 16 silver salmon during 94 hours of fishing for a catch per hour of 0.17 fish.

Ninilchik River:

A total of 40 fishermen were contacted during eight creel census checks made from August 3 through September 13. They caught a total of 35 silver salmon during 84 hours of fishing for a catch per hour of 0.42 fish. On September 6 an estimated 500 silver salmon were observed in the first 300 yards of the Ninilchik River. Several hundred silvers were in this same section on September 15.

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*Prepared by:*

David A. Watsjold
Fishery Biologist

*Approved by:*

s/Howard E. Metsker
D-J Coordinator

s/Rupert E. Andrews, Director
Division of Sport Fish

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